2. *On some small* TRILOBITES *from the* CAMBRIAN ROCKS *of* COMLEY (SHROPSHIRE). By EDGAR STERLING COBBOLD, F.G.S. (Read December 1st, 1909.)

[PLATES III–VIII.]

THE trilobites described in this paper were mainly collected during the progress of the excavations at Comley, which formed one of the subjects of the Report[1] of the Geological Excavations Committee of the British Association, read at the Dublin Meeting, 1908.

The majority of the specimens were derived from the preliminary excavation in the fields, some 200 yards south of the well-known Comley Quarry. This excavation cuts transversely through the same set of beds as those that are worked in the quarry, and, though of only a very shallow depth, it exhibits the most complete section as yet exposed of the local junction between the *Olenellus* and *Paradoxides* divisions of the Cambrian. Between the *Olenellus* Limestone, which in the quarry yields *Olenellus (Holmia) callavei*, Lapw., and the Conglomeratic Grit, which in the same quarry yields *Paradoxides groomii*, Lapw.,[2] there is intercalated some 4 feet of grey limestone. Provisionally, I divide this into the following bands, in descending order (see text-fig., p. 20):—

			Thickness in inches.
Conglomeratic Grit (*Paradoxides*).			
Black Limestone			12
Grey	do.	Uppermost part	3
Do.	do.	Upper part	6
Do.	do.	Middle part (reddish purple)	12
Do.	do.	Lower part (greenish grey)	9
French Grey Limestone			6
Olenellus Limestone.		*Olenellus (Holmia).*	

I hesitate to assign any definite numbers or letters to these beds, until more is known as to their faunal characteristics, which will throw light on their natural grouping. All these limestones above the *Olenellus* Limestone contain black nodules of, probably, phosphatic matter.

The trilobites occur as aggregations of many parts or fragments of parts, indiscriminately mixed three or four species together, and usually preserve their original form and convexity. In most cases the test has also been preserved, either wholly or in part; and where this has been the case I have often been enabled to correlate free cheeks, pleuræ, etc. with the cranidia, in a way that would have been quite impossible if the surface characters had not been retained and propinquity only had to be relied upon. In the descriptions I have set forth the evidence upon which I have relied in making my correlations, so that future workers may be able to distinguish between what is actual fact and what is only matter of inference.

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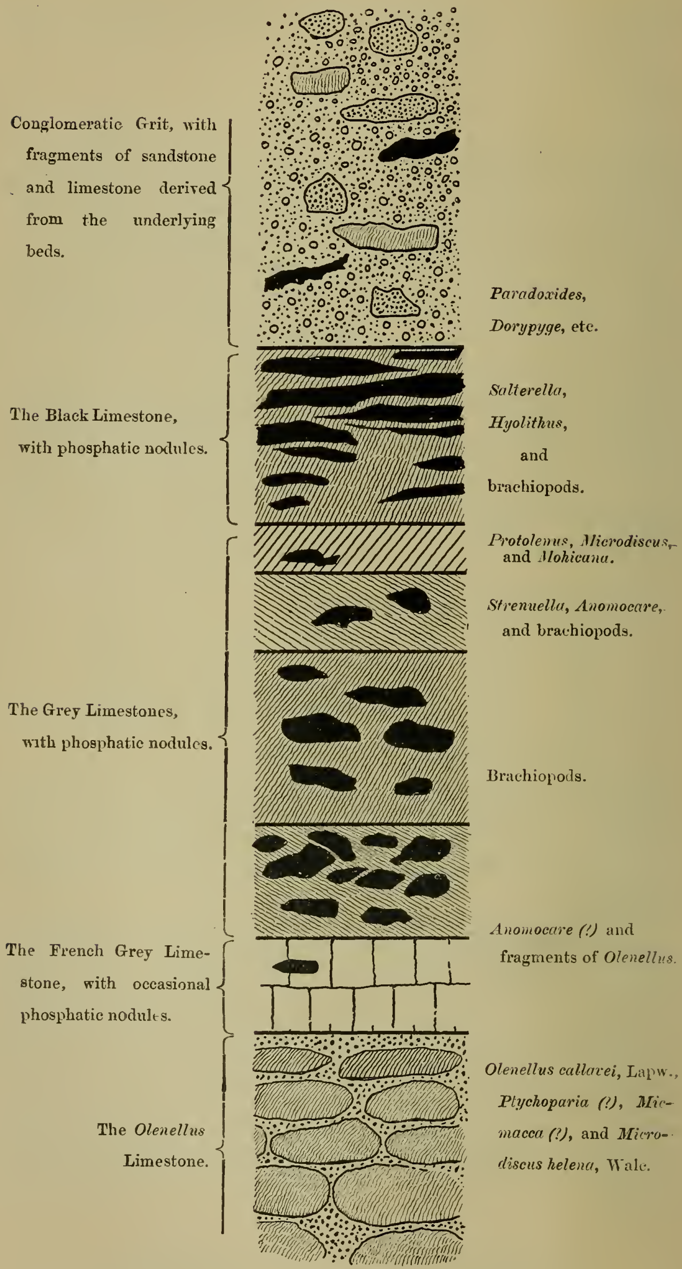
[1] Rep. Brit. Assoc. 1908 (Dublin) 1909, pp. 231–42.

[2] Geol. Mag. dec. iii, vol. viii (1891) p. 532 & footnote.

Vertical section 200 yards south of the Comley Quarry, on the scale of, approximately, 1 inch to 1 foot.


Conglomeratic Grit, with fragments of sandstone and limestone derived from the underlying beds.
Paradoxides, *Dorypyge*, etc.
The Black Limestone, with phosphatic nodules.
Salterella, *Hyolithus*, and brachiopods.
Protolenus, *Microdiscus*, and *Mohicana*.
Strenuella, *Anomocare*, and brachiopods.
The Grey Limestones, with phosphatic nodules.
Brachiopods.
Anomocare (?) and fragments of *Olenellus*.
The French Grey Limestone, with occasional phosphatic nodules.
The *Olenellus* Limestone.
Olenellus callavei, Lapw., *Ptychoparia (?)*, *Micmacca (?)*, and *Microdiscus helena*, Walc.

Microdiscus.

MICRODISCUS COMLEYENSIS, sp. nov. (Pl. III, figs. 1–4.)

E. S. Cobbold, *Microdiscus* sp., Rep. Brit. Assoc. 1908 (Dublin) p. 236 (1909).

This species is founded upon the examination of over seventy head-shields and pygidia, the thoracic segments being unknown.

CEPHALON: Size—moderate; length = from 3 to 4 millimetres.

General form.—Semi-elliptical; proportion of length to width about 3 to 4; evenly rounded at front and sides, and having a sinuous posterior border; postero-lateral angle gently rounded.

General convexity.[1]—Considerable, about $\frac{1}{4}$.

Glabella.—About seven-eighths of the total length and a third of the width of the shield; subconical, widest at the posterior end, which is also somewhat swollen and campanulate; anterior end semicircularly rounded, and reaching to the flattened marginal rim; posterior end, with which the occipital ring is entirely confluent, rounded elliptically, and projecting considerably beyond the posterior margin of the shield; no transverse furrows.

Axial furrows.—Sharply impressed; wider in the internal cast than on the exterior.

Cheeks.—Gently and evenly convex; greatest elevation, about half the height of the glabella at a point rather in advance of the middle of their length; the exterior boundary is nearly a quadrant of a circle, which is tangential to the apex of the glabella.

Postero-lateral border.—A somewhat sinuous rim, raised (? geniculate) at a point about three-fourths of the width outwards. At the posterior angle there is a little depression crossing the margin, and separating the side marginal rim from the postero-lateral border.

Marginal rim.—Standing out horizontally from the cheeks, and then bent downwards; rather narrow at the sides; widening to about an eighth of the length of the head-shield in front of the glabella; without tubercles[2]; having no groove in its rear.

PYGIDIUM: General form.—Approximating very closely to that of the head-shield, but rather more convex.

Axis.—Tapering regularly backwards and extending the full length of the shield; anterior end projecting a little beyond the general line of the margin with a narrow articulating rim (rarely preserved); posterior end rounded, and having the appearance of being pressed down into the confluent swollen side-lobes; divided into about seven annulations, hardly discernible on the exterior, but sometimes seen in the cast of the interior [508][3] (Pl. III, fig. 4).

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[1] The fractions used under this heading, in this and the following descriptions, to express the convexity, indicate the proportion borne by the greatest height of the head-shield to its transverse width.

[2] When viewed sideways, some of the specimens exhibit a very slight irregularity in the horizontal surface of the marginal rim towards the sides of the head-shield, suggestive of incipient (or decadent) tubercles. They are so badly defined, that they can neither be counted nor shown on the figures.

[3] The numbers in square brackets are those attached to the specimens themselves.

Axial furrow.—Narrow and sharply impressed on the exterior, wider on the internal cast.

Side-lobe.—Evenly convex; curving down from the axial furrows; confluent round the tip of the axis, where also it frequently overhangs the marginal rim; it has one well-marked groove close to the anterior border, which is a little raised at its edge.

Marginal rim.—Narrow all round, and bent downwards rather more decidedly than in the head-shield.

Test.—Relatively to other trilobites from the same rock, thick and firm and resistant to weathering; marked by numerous impressed punctæ set at fairly even distances and represented on the interior by raised spots, which are reproduced as punctæ on the internal cast.

The variations are very slight, chiefly consisting in the amount of inflation of the swollen parts.

This species appears to be somewhat intermediate between *M. speciosus*, Ford, and *M. punctatus*, Salter: with both it agrees in having a punctate test, and a simple form of pygidium; but, whereas the present species has about seven annulations of the axis, *M. punctatus* is described as having nine, and *M. speciosus* eleven.

The enlarged occipital ring, coalescent with the glabella, may be paralleled in *M. punctatus*, but is not produced in the form of a spine. From both these species it differs in having a plain marginal rim to the head, and in the proportionate length of the glabella.

In the plain marginal rim and punctate test it may be paralleled with *M. lenaicus*, von Toll[1]; but it differs from that species, in having a longer glabella and more convex axis to both cephalon and pygidium.

Locality and horizon.—The grey limestone of Comley, from the uppermost band (3 inches thick) at the excavation 200 yards south of the quarry.

MICRODISCUS LOBATUS (Hall). (Pl. III, figs. 17 & 18.)

J. Hall, 'Pal. N. York' vol. i (1847) p. 258 & pl. lxvii, figs. 5 *a*–5 *f*.
C. D. Walcott, U.S. Geol. Surv. Bull. 30 (1886) p. 156 & pl. xvi, figs. 1, 1 *a*, 1 *b*; and 10th Ann. Rep. U.S. Geol. Surv. 1888–89 (1890) p. 632 & pl. lxxxi, figs. 4, 4 *a*, 4 *b*.
P. Lake, 'British Cambrian Trilobites' Monogr. Palæont. Soc. vol. lxi (1907) pt. ii, p. 32 & pl. iii, figs. 4–6.

Head-shields of this species from the same locality and bed as *M. comleyensis*, sp. nov., have been figured by Mr. Philip Lake in his monograph. Since that portion of his work was published, several pygidia referable to *M. lobatus* have been found, one of which [445], together with a very well-preserved head-shield [453], is figured on Pl. III.

Locality and horizon.—Comley, from the uppermost band of grey limestone, and from the next lower band, at the excavation 200 yards south of the quarry. It is plentiful there.

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[1] 'Beitr. z. Kenntn. d. Sibirischen Cambrium' Mem. Acad. Imp. Sci. St. Petersb. ser. 8, vol. viii, no. 10 (1898) p. 23 & pl. i, figs. 6–8, 10, 11, 14–17, 24.

MICRODISCUS HELENA, Walcott. (Pl. III, figs. 14–16.)

C. D. Walcott, Proc. U.S. Nat. Mus. vol. xii (1889) p. 40; and 10th Ann. Rep. U.S. Geol. Surv. 1888–89 (1890) p. 632 & pl. lxxxi, figs. 1–1 *a*.
P. Lake, *Microdiscus* sp., 'British Cambrian Trilobites' Monogr. Palæont. Soc. vol. lxi (1907) pt. ii, p. 34 & pl. iii, fig. 8.
E. S. Cobbold, *Microdiscus* sp., cf. *helena*, Walc. Rep. Brit. Assoc. 1908 (Dublin) 1909, p. 235, & *Microdiscus* sp., *ibid.* p. 237.

Since Mr. Lake figured the single pygidium from the *Olenellus* Limestone of the Comley Quarry, additional and better-preserved specimens have been found from the same horizon at the excavation 200 yards to the south. He has kindly examined these, and tells me that he regards them as quite confirming his opinion that Dr. Walcott's species is represented at Comley.

Three pygidia [385, 386, 387], in which the test and original convexity are preserved, are figured on Pl. III. These show four or five annulations of the axis, in addition to the articulating surface in front and a terminal posterior portion: the side-lobes are confluent beyond the end of the axis, and are marked by four impressed lines, which are less strongly shown on the exterior than on the interior. The margin is narrow and convex. The convexity of the shield seems to vary from about $\frac{1}{4}$ to $\frac{1}{5}$, and the surface of the test appears to be smooth. The length is from 2 to $2\frac{1}{2}$ millimetres.

Locality and horizon.—Comley, from the *Olenellus* Limestone of the quarry; from the excavation 200 yards south thereof; and from the same horizon at an excavation at the northern end of Dairy Hill, 200 yards to the south-east.

MICRODISCUS SPECIOSUS, Ford.

S. W. Ford, Am. Journ. Sci. ser. 3, vol. vi (1873) p. 137 & figs. 2 *a*–2 *b*; and vol. xiii (1877) p. 141.
C. D. Walcott, U.S. Geol. Surv. Bull. 30 (1886) p. 154 & pl. xvi, figs. 3, 3 *a*–*c*; and 10th Ann. Rep. U.S. Geol. Surv. 1888–89 (1890) p. 632 & pl. lxxxi, figs. 5, 5 *a*–*c*.
P. Lake, 'British Cambrian Trilobites' Monogr. Palæont. Soc. vol. lxi (1907) pt. ii, p. 33 & pl. iii, fig. 7.

A good head-shield from my collection has been figured by Mr. Lake in his monograph.

With the exception of two imperfect and rather doubtful pygidia, no further remains of this species have come to light.

Locality and horizon.—Comley, from the upper part of the grey limestone, at the excavation 200 yards south of the quarry.

Ptychoparia, Corda.

PTYCHOPARIA (?) ATTLEBORENSIS, Sh. & F. (Pl. III, figs. 11–13.)

N. S. Shaler & A. N. Foerste, Bull. Mus. Comp. Zool. vol. xvi (1888) p. 39 & pl. ii, fig. 14.
C. D. Walcott, 10th Ann. Rep. U.S. Geol. Surv. 1888–89 (1890) p. 649 & pl. xcv, fig. 2.

In my collection there are some fifteen or more specimens of a minute cranidium which answers very closely to Dr. Walcott's figures and to his quotation of the original description of this species.

There is but one point that I have not identified. Shaler & Foerste say that 'the most marked feature of the fixed cheeks is the existence of a depression on their postero-lateral outline.' Unless this be a reference to the wide postero-lateral groove, which expands outwards, this feature is not present in the Comley specimens.

The most marked feature about these fixed cheeks is their triangular aspect, as viewed from above. The two cheeks, taken together, form a square elevated area set diagonally upon the somewhat quadrate cranidium; this feature comes out almost too strongly in my figures.

The specimens figured [405, 406, 576] do not show another feature mentioned by the authors of the species. After referring to the expanded 'anterior border,' they say that 'near the lateral margins of the border, or rather near the facial suture, there are sometimes two or three low tubercles visible.' One of the Comley specimens (a very friable internal cast) exhibited similar tubercles when first found, and was mistaken for a head-shield of *Microdiscus helena*, Walc., until the eye-lobe was exposed by removal of the soft matrix. The enlarged base of the combined glabella and occipital ring lent colour to the illusion.

The Comley specimens are about 2 millimetres long; in the original description the head is said to be 'small, often minute, in the largest specimen 4 mm. long, usually 2·6 mm.'

Locality and horizon.—Comley, from the *Olenellus* Limestone, at the excavation 200 yards south of the quarry, and also in the Dairy Hill excavation. It is plentiful.

PTYCHOPARIA (?) ANNIO, sp. nov. (Pl. III, figs. 5–8.)

Four incomplete head-shields [401, 402, 403, 404] form the only material available for description, but the features are so well marked that the specimens seem worthy of specific designation. The generic reference is quite provisional.

CRANIDIUM: Size—minute; length = about 2½ millimetres.

General form.—Irregularly pentagonal; proportion of length to width = 3 : 4.

General convexity.—While the features are all in themselves very convex, the general level of the head-shield is nearly horizontal, but the sides appear to be much depressed.

Glabella.—Strongly convex; distinct from the occipital ring; parabolic; almost pyriform in the cast, see specimen [401] (Pl. III, fig. 7); most elevated near the posterior end; very depressed anteriorly, as though it had been pressed down into the head-shield; without furrows; about three-fifths of the total length of the head-shield.

Occipital furrow.—Entire; strongly impressed at the sides, less so in the middle.

Occipital ring.—Equal in width to the glabella; bearing (the base of) a strong spine or large tubercle [401] (Pl. III, fig. 7).

Axial furrow.—Very deep and wide.

Fixed cheeks.—Anterior limit marked by a curve of rather long radius, convex forwards and passing just clear of the apex of the glabella. In transverse section the cheeks rise steeply out of the axial furrows, then become horizontal, and finally rise to the rather wide and elevated eye-lobe (Pl. III, figs. 5 & 6); the posterior angle is much depressed; the posterior margin of each cheek is furnished with two curious little circular mounds [401, 402] (Pl. III, figs. 5, 6 & 8).

Ocular ridge.—Well defined on the internal cast (Pl. III, fig. 7); arising on the outer side of the axial furrow a little below the apex of the glabella, and passing almost directly across the cheek to the eye-lobe; not always visible on the exterior.

Eye-lobe.—About a third of the length of the glabella, and situated far out and rather forward; the anterior end of the eye-lobe is distinctly higher than the posterior.

Posterior margin.—Unknown.

Frontal limb.—Swollen up to a great height in the middle, as high as, or higher than, the maximum elevation of the glabella, from which it is separated by a deep hollow; the prominence decreases in width and falls away in height to right and left, but continues to be well marked and is separated from the cheeks by the continuation of the deep hollow already mentioned.

Facial suture.—Somewhat doubtful; anterior branch (Pl. III, fig. 6) short and direct to the margin; posterior branch, so far as can be made out from the specimen (fig. 5), taking a sigmoidal curve outwards to cut the posterior margin in line with the outer edge of the eye-lobe.

Test.—Finely granular, as seen under a strong lens.

The prominent front and elevated eye-lobes, together with the depressed apex of the glabella, suggested when first seen the coiffure of a clown, hence the proposed specific name. A restoration of the complete cranidium, based upon the three specimens figured, is given in Pl. III, fig. 8.

Locality and horizon.—The *Olenellus* Limestone of Comley, from the excavation 200 yards south of the quarry.

This species is very closely allied to the Siberian form *Ptychoparia czekanowskii*, von Toll.[1] It differs (i) in the shape of the glabella; (ii) in the front outline of the cranidium; (iii) in the strength of the nuchal spine, which in the Siberian species is described as entirely replacing the occipital ring. In E. von Toll's figures there is an uncertain indication of an upturned marginal rim, in advance of the swollen frontal limb; no trace of this is to be detected in the Comley form.

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[1] 'Beiträge zur Kenntniss des Sibirischen Cambrium' Mem. Acad. Imp. Sci. St. Petersb. ser. 8, vol. viii, no. 10 (1898) p. 21 & pl. i, fig. 1.

Nearly allied also is the same author's second Siberian species, *Ptychoparia meglitzkii*,[1] which, however, has weak glabellar furrows and differently formed fixed cheeks.

Pt. (?) prospectensis, Walcott,[2] has a circular swelling in front of the glabella of equal elevation with it, and a fixed cheek extending forwards, with prominent eye-lobes on the outer margin. This form would seem to be a more distant ally of our species, but it has an anterior border to the frontal limb.

Pt. (?) linnarssoni,[3] Walcott (not the *Pt. linnarssoni*, Brögger). is another species with a swelling on the frontal limb in front of the glabella, and elevated fixed cheeks extending forwards with a rather prominent eye-lobe, but the general shape of the cranidium and the widely diverging posterior branches of the facial suture give a very different aspect to the head-shield. It, too, has an anterior border to the frontal limb.

A still more divergent form has been described by Dr. Walcott as *Pt. (?) pernasutus*,[4] in which the glabella has much the same general shape as the Comley species; but in this case there is an extravagantly enlarged frontal limb, which runs out forwards into a point and is only slightly convex. It is somewhat reminiscent of *Anomocare acuminatum*, Ang.

In all these forms, which have been doubtfully referred to *Ptychoparia*, there seems to be a relic of an aboriginal trilobation of the anterior portion of the head-shield.

Micmacca, Matthew.

Under this name Mr. G. F. Matthew describes

> 'A group of trilobites with large, rather prominent, cylindrical glabella, which extends almost to the front of the shield; and with continuous eye-lobes and a short, direct posterior extension of the dorsal suture.' (Trans. N.Y. Acad. Sci. vol. xiv, 1895, p. 141.)

There are several forms derived from the *Olenellus* Limestone of Comley which I provisionally refer to this genus, although they are almost as closely allied to *Ellipsocephalus*, Zenker, and again have affinities with some forms of *Anomocare*, Angelin, and with Mr. Matthew's suggested subgenus (*Strenuella*) of *Agraulos*, Corda.

The true generic position of these Comley fossils can hardly be ascertained, until the thoracic segments and pygidia are forthcoming.

For the present, I divide them into two species: one a very minute form, and thereby differing strongly from Mr. Matthew's type species; the other of moderate size, and presenting several variations, so that it is possible that a third or even a fourth species may be represented.

Their occurrence in the same bed of rock with *Olenellus* (*Holmia*) would seem to indicate that they come from a relatively earlier horizon than the Acadian forms, and their alliances with other genera suggest an earlier stage in development.

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[1] Mem. Acad. Imp. Sci. St. Petersb. ser. 8, vol. viii, no. 10 (1898) p. 22 & pl. i. fig. 2.

[2] 'Palæontology of the Eureka District' U.S. Geol. Surv. Monogr. viii, (1884) p. 46 & pl. ix, fig. 20.

[3] *Ibid.* p. 47 & pl. ix, figs. 18, 18 *a*.

[4] *Ibid.* p. 49 & pl. x, figs. 8, 8 *a*, 8 *b*.

MICMACCA (?) ELLIPSOCEPHALOIDES, sp. nov. (Pl. VII, figs. 8 & 9 & Pl. VIII, fig. 1.)

This species is founded upon five specimens in my own collection, and upon a similar number from the British Museum (Natural History) collection at South Kensington; and I would here wish to acknowledge my indebtedness to the Keeper of the Geological Department for the loan of the latter specimens.

I take as the type-specimens [413] of my own collection and [J 12905] from the British Museum, and to this typical form specimens [955, 200, & 201] are also referred.

The remainder of the British Museum specimens [J 12900, J 12901, J 12902, J 12904] and one of my own [414] will be noticed later as varieties.

Nos. 413 and 955 have the test in excellent preservation. In J 12901 it is slightly decomposed and of a beautiful chalky white, like so many of the fossils from the *Olenellus* Limestone of the Comley Quarry. The other specimens have the test more or less decomposed, or actually removed.

CRANIDIUM: Size—rather small; length=5 to 7 millimetres.

General form.—Trapezoidal, widest behind; widely rounded in front; proportion of length to width = 3 : 4.

General convexity.—Considerable; apparently about $\frac{1}{4}$; with features in strong relief.

Glabella.—Without the occipital ring, about two-thirds of the length of the head-shield; wide; very convex transversely and also longitudinally; highest in the middle of the length; parallel-sided, with semicircularly rounded apex; marked at the sides by three pairs of furrows, of which the posterior is strongly curved backwards, the next is similarly directed but not so strongly, and the third is only sometimes discernible.

Occipital furrow.—Shallow and wide; entire; somewhat curved backwards, and weak in the middle of its length.

Occipital ring.—As wide as the glabella; expanded in the middle to a rounded angle; and bearing a tubercle or incipient spine directed backwards.

Axial furrow.—Wide; slightly hollowed and not marked by any impressed line; not traceable round the apex of the glabella.

Fixed cheeks.—Suggestive of spherical triangles; flatly convex, rising a very little from the axial furrow, almost flat transversely to it, curving over towards a groove (deepest posteriorly) in rear of the eye-lobe; anteriorly they fall away in elevation, and merge into the frontal limb beyond the ocular ridge; posteriorly they are limited by a steep curve down to the postero-lateral limb.

Eye-lobe.—One-third the total length of the head; the posterior end, which is a little enlarged, does not quite reach the postero-lateral limb; from this point the surface of the lobe, which is always raised above the depressed side of the cheek, rises distinctly to the forward end, where it drops away abruptly to the place of the ocular ridge.

Ocular ridge.—Arising from the outer side of the axial furrow a little in advance of the point where the side of the glabella begins to curve round to the apex; very slightly elevated, and sometimes only marked by a slight hollow or furrow behind it which connects with the hollow in rear of the eye-lobe.

Postero-lateral limb.—A triangular area, consisting of a hollow which widens outwards, and a slightly raised margin which is strongly geniculated just within the distance outward of the eye-lobe, the geniculation being almost a tubercle. Beyond this point the surface of the limb falls rapidly down to the facial suture.

Frontal limb.—Narrow, not more than an eighth of the length of the head; subequally divided into a flat area (or a shallow hollow) and a slightly convex marginal rim; both these features can be followed in one of the specimens to right and left as far as the facial suture.

Facial suture.—Anterior branch nearly straight forwards and parallel with the axis of the head; posterior branch a little curved outwards, and extending as far out as the extreme limit of the eye-lobe.

Test.—Apparently thick and strong, sometimes almost polished on the surface of the glabella; having a finely granular aspect on the fixed cheeks, and a few short raised lines on the front margin.

Two detached pleuræ occur on the same little piece of rock with the cranidium [413]. These are smooth, widely furrowed, and strongly geniculated, but the ends are not visible. I cannot with confidence assign them to this species, because at least two other trilobites are represented by fragments on the same little block of limestone.

This form of the species seems to me to be intermediate between *Micmacca* and *Ellipsocephalus*. From the type species of the former it differs in the somewhat extended frontal limb, and in the rather wider postero-lateral limb with the consequent lengthening of the posterior branch of the facial suture. From the latter genus it differs in the fact that the glabella is not expanded in front, nor is it pentagonal in outline, nor is the frontal limb strongly bent downwards in front.

The species seems nearest to *Micmacca recurva*, Matthew, but the eye-lobe of that species, as represented in his figure, extends farther back, the postero-lateral limb is narrower, and the ocular ridge seems to be differently developed; there is no 'obscure tubercle' on the side of the glabella in the Comley form, which also is smaller.

MICMACCA ELLIPSOCEPHALOIDES, var. SPINOSA. (Pl. VIII, fig. 5.)

Specimens [414 & J 12900] show the tubercle on the occipital ring developed into a short spine directed backwards; the axial furrow is more distinctly hollowed, and traceable almost to the apex of the glabella; the fixed cheeks appear to be rather narrower; the hollow parallel with the eye-lobe and the ocular ridge is more distinct; the frontal limb is thickened and curved downwards to the front margin, with an extension forwards equal to one-third of the length of the glabella, and, though flattened in front of this latter feature, does not show any decided hollow or marginal rim.

MICMACCA ELLIPSOCEPHALOIDES, var. STRENUELLOIDES. (Pl. VIII, figs. 3 & 6.)

Two cranidia [J 12904 & J 12902] are somewhat wider across the base and narrower in front between the sutures than is the case in the type-specimens, and in this respect bear a resemblance to *Agraulos* (*Strenuella*). The frontal limb stands out horizontally to a greater distance, and has the form of the toe of a slipper when seen from the side; and in one specimen [J 12902] the glabella is narrower in front than behind. In both cases the occipital ring is incomplete, so that it is impossible to say whether it bore a spine or a tubercle. This last specimen also shows traces of at least seven thoracic segments in place: these are so much damaged, that it can only be said that the number is incomplete; that they have a very convex axis; that the pleuræ stand out horizontally for a distance equal to about two-thirds of the width of the axis, and are there bent downwards at a steep angle to their terminations, which are also bent backwards and probably ended in sharp points. The traces of these points in the rock are concave throughout, implying the existence of an extended doublure.

On the same piece of rock there is a well-preserved fixed cheek, showing the sutures, and approaching more nearly to the type (Pl. VIII, fig. 4).

MICMACCA ELLIPSOCEPHALOIDES, var. SENIOR. (Pl. VIII, fig. 2.)

A cranidium of larger dimensions (length = 13 mm.) is represented in the specimen [J 12901] shown in fig. 2. There is a robustness about it which suggests that it is an older individual. It departs from the type, principally in the greater proportionate width across the posterior branches of the facial sutures; in the occipital furrow being quite lost in the middle of its length, but wide and deep at the sides; and in the very thick but shortened frontal limb, with a decided hollow between it and the glabella. The occipital ring seems to have been devoid of spine or tubercle.

The divergences between these four forms are, when considered together, too slight to warrant a separation into diverse species, and I am doubtful whether they have any permanent varietal importance. It seems more probable that the species was in a state of flux and that it was not until later, if at all, that it crystallized out into forms with well-marked permanent differences.

Locality and horizon.—Comley, from the *Olenellus* Limestone of the quarry and of the excavation 200 yards south of it.

MICMACCA (?) PARVULA, sp. nov. (Pl. III, figs. 9 & 10.)

One imperfect internal cast of the cranidium [412] and one fragment with the test preserved [411], and showing the glabella and fixed cheek, form the only material at present available for description.

CRANIDIUM: Size—minute; 2 to 2½ millimetres long.

General form.—Subquadrangular, with rounded front.

General convexity.—Rather flat; curving down somewhat at the front, and perhaps at the sides.

Glabella.—Moderately convex; touching the front margin; widening forwards beyond the ocular ridge; with four pairs of incomplete furrows, which are slightly impressed at the sides and very evenly distributed in the length.

Occipital furrow.—Wide and shallow; traceable all across.

Occipital ring.—Narrower than the glabella, and produced backwards to a point or short spine.

Axial furrow.—Wide and very slightly impressed; increasing in strength forward of the ocular ridge.

Fixed cheeks.—Subquadrangular; as wide as the glabella and nearly flat; falling a little to a hollow behind the eye-lobe; limited anteriorly by the ocular ridge, and posteriorly by a steep descent to the postero-lateral groove.

Ocular ridge.—Arising from the outer side of the axial furrow a little posterior to the anterior glabellar furrow; passing outwards at right angles to the glabella to join the eye-lobe by a bold curve.

Eye-lobe.—Fully half the length of the head; rising rather steeply from the depressed edge of the fixed cheek; reaching backwards nearly to the posterior marginal groove.

Postero-lateral limb.—A groove margined by a slightly raised and rounded ridge, which is geniculated almost as far out as the eye-lobe.

Frontal limb.—Not wholly known; apparently it consists of a narrow upturned fillet touching the glabella, and separated from it by a distinctly impressed line. This fillet is produced on each side to form the anterior curve of the shield; between this and the ocular ridge there seems to be a comparatively wide flat area.

Facial suture.—Anterior branch unknown; posterior branch apparently short and direct to the posterior margin immediately behind the eye-lobe.

TEST.—Very finely granular.

This little species differs from Mr. G. F. Matthew's type for the genus (*M. matthewi*) in its minute size; and, but for the width of the glabella, it might well be a larval form of this genus. The long and distant eye-lobe and the glabella reaching the front margin are both (*fide* Matthew)[1] embryonic features in allied genera.

Locality and horizon.—Comley, from the *Olenellus* Limestone of the quarry, and of the excavation 200 yards south thereof.

[1] Trans. Roy. Soc. Can. vol. v, sect. iv (1887) pp. 123 *et seqq.*

Agraulos, Corda.

Subgenus **Strenuella**, Matthew.

In 1886 Mr. Matthew[1] called attention to the divergence of *A. strenuus*, Bill., from the type of Corda's genus, and proposed the name of *Strenuella* for a subgenus, of which Billings's species would form the type; and in 1887[2] he referred (but with a note of doubt) his species *A. (Strenuella?) halliana* to the same subgenus.

A form occurs at Comley which seems closely related to *A. strenuus*, var. *nasutus*, Walcott, and should come under the same subgenus. It has some points of resemblance with *Anomocare*, Angelin, but would seem to have a wider head-shield than the type of the genus, and a small pygidium very different from the rounded pygidia described and figured by Angelin. It appears to me that *Strenuella* might well be adopted as the name for a genus intermediate between *Agraulos* and *Anomocare*; but without access to specimens of *Agraulos strenuus*, Bill. (which should form the type species), I cannot sketch out a generic diagnosis.

AGRAULOS (STRENUELLA) SALOPIENSIS, sp. nov. (Pl. IV, figs. 1–9.)

E. S. Cobbold, *Anomocare*, cf. *Agraulos strenuus*, var. *nasutus*, Walc., Rep. Brit. Assoc. 1908 (Dublin) 1909, p. 236.

Fragments of this species occur in abundance in one band of the grey limestone of Comley; but they are difficult of extraction, owing to the strong relief of the features.

I have portions of twelve or more individual cranidia in my collection, the most complete, though not the largest, of which [161] is figured.

The fragments of this species are intimately mixed in the rock with those of another of about the same size, and the correlations made below, of pygidium, thoracic segments, and free cheeks with these cranidia, are necessarily matters of inference.

CRANIDIUM: Size.—Length (exclusive of the nuchal spine) = from 7 to 10 millimetres; the width across the eye-lobes is about half as much again.

General form.—Broadly subquadrangular, with a very widely curved front and a somewhat sinuous posterior border, from which the long nuchal spine projects backwards.

Convexity.—The glabella is strongly convex, the fixed cheeks are more or less horizontal, and the sides of the head-shield dip steeply down. The convexity works out at about $\frac{1}{4}$.

Glabella.—Almost semicircular in convexity; somewhat parabolic in outline; width, about a third of that of the cranidium; length, about three quarters of that of the shield without the nuchal spine; three pairs of furrows directed strongly backwards are sometimes visible at the sides, but they are frequently almost obsolete.

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[1] Trans. Roy. Soc. Can. vol. iv, sect. iv, pp. 151, 154.

[2] *Ibid.* vol. v, sect. iv, p. 132.

Occipital furrow.—Sometimes traceable all across, sometimes only represented by impressions at the sides.

Occipital ring.—Merged into the base of a very strong nuchal spine, which projects backwards over several thoracic segments.

Axial furrow.—The change in vertical curvature all round the glabella indicates its limits very definitely, but there is no impressed line or hollow.

Fixed cheek.—Subquadrangular; as wide as the glabella; almost horizontal for about half its width, rising a little in the third quarter, and falling steeply to a hollow or groove, the outer margin of which rises to form the eye-lobe; posteriorly the surface of the cheek falls steeply to the postero-lateral groove; anteriorly it slopes gently and evenly down to the frontal limb, extending a very little beyond the ocular ridge.

Eye-lobe.—A little less than a third of the length of the head-shield (without the spine); rather nearer to the posterior than to the anterior margin; elevated at its interior end above the ocular ridge, and having its upper surface distinctly inclined backwards as seen from the side.

Ocular ridge.—Almost obliterated at its commencement near the glabella, but gaining in definiteness, by reason of the slight depression behind it, as it crosses the front slope of the cheek towards the eye-lobe.

Frontal limb.—Extending for a quarter of the length of the head-shield in front of the glabella; composed of a deep and wide rounded hollow and a very convex marginal rim: the hollow and rim lose intensity to right and left, and are hardly discernible at the line of the facial suture.

Postero-lateral limb.—Consisting of a groove widening considerably towards the facial suture, and a well-marked but rather narrow raised rim. At a distance from the glabella equal to the width of its base there is a strong geniculation, sometimes rising so much that it might be called a tubercle; beyond this the surface of the limb slopes down steeply to the facial suture, and the groove and raised rim gradually fade away.

Facial suture.—Not well seen from above, owing to the curving over of the sides of the cranidium; the anterior branch is short, subparallel to the axial line of the shield, and curves very slightly outwards; the posterior branch is somewhat sigmoidal, but also short, and meets the posterior border behind the eye-lobe.

Test.—The test in this species seems very thick and strong, and all the minor features, such as the glabellar grooves, or ocular ridge, are softened or almost obliterated from this cause. I have not seen any internal casts. The actual surface is smooth, but not polished, and under a strong magnifier appears to be of extremely fine grain.

As a rule, no surface-marks are visible on the upper surface; but on one nuchal spine attached to a glabella [158] there are some faint and very slightly raised lines, running longitudinally, and on one front border [945] there are similar marks almost on the under surface.

Free cheeks.—Among the innumerable fragments associated with these cranidia and with other similar fragments belonging to the next species to be described, there are several free cheeks which I feel confident may be assigned to this species.

One of the most perfect [170] is figured in four aspects (Pl. IV, figs. 6 *a*–6 *d*): fig. 6 *a* is a representation of the cheek as it lies flat in the rock; fig. 6 *b* is the view presented as seen from the side of the complete organism; fig. 6 *c* is the view presented as seen from above (as nearly as I can judge); fig. 6 *d* is an enlargement of the spine, to show the surface-markings. These markings correspond very closely with those on the spine and front border above mentioned, but they are more pronounced. They consist of raised, inosculating, flattened lines, looking like tiny ribbons of gossamer, irregularly arranged subparallel with the margin. The rest of the surface is of exactly the same texture as the associated cranidia.

The transverse curvature of the cheek-margin agrees with that of the cranidium, and the lower branch of the facial suture on the cheek would (with allowances for differences in size and individual) fit fairly well to the suture shown on the head-shield.

The flat area of the cheek is very small; the rise to the eye is steep and pronounced; the marginal fold is produced at the genal angle into a stout spine, somewhat oval in section, and this projects (to judge by fig. 6 *c*) but slightly from the general outline of the thorax.

The associated thoracic segments that may be referred to this species are represented in Pl. IV, figs. 2–4 and 7–9. They are characterized by a very convex axis usually, if not invariably, more than a semicircle; and by a pleural lobe which is horizontal for half its length, and has a strong geniculation at a distance out subequal to the transverse diameter of the axis, the tip being bent down at an angle of 60° to 65°. In some axis-rings there is a very small central tubercle; others are provided with the base of a stout spine directed vertically upwards, and seen, in one instance [176] (fig. 4), to rise fully three-quarters of the height of the ring without change of direction. The extremities of the pleuræ are rarely easy to observe: in [162] fig. 3 the whole tip is corroded and indefinite; in [164] fig. 2, which was carefully excavated with a needle, the tip appears to be distinctly rounded; in [180] fig. 7 a distinct but somewhat incipient hook is observed; in [944] fig. 8 the hook is more pronounced; and in [948] fig. 9 a much stronger hook is seen. The last two are detached tips unconnected with any axis-ring, but showing an angle of geniculation of about 60°.

Summarizing from the above-quoted specimens, the characters of the thorax may be described as follows:—

Thorax.—Number of segments unknown.

Axis.—Very convex; anterior segments plain, or provided with a central tubercle; median and posterior segments all (?) provided with strong cylindrical spines, directed vertically upwards; articulating surface marked off from the body of the ring by a decided transverse hollow. At each side of the axis there is a small cushion-shaped thickening, perhaps serving to strengthen the attachment to the pleura.

Pleura.—Standing out nearly at right angles to the axial line; horizontal for a distance subequal to the transverse diameter of the axis; then suddenly geniculated and bent downwards at an angle of 60° to 65°; the bent portion is subequal in length to the horizontal portion, and slightly convex outwards; the extremities are rounded or armed with incipient hooks, which, possibly, become more pronounced posteriorly. The surface of each pleura is provided with a front and a back rib, with a furrow between them: the back rib is marginal throughout; the front rib is marginal to the geniculation, from which point it bends a little backwards, leaving a narrow facet in front of it, and causing the furrow to contract in width, until it disappears at a distance from the extremity equal to about the width of the pleura; where a hook is present, it is formed of a continuation of this front rib carried backwards.

Surface.—Smooth or very finely granular, with a slightly coarser granulation at the extremities.

A fragment [274] of a pygidium (Pl. IV, fig. 5) may be referred to this species with a high degree of probability. The surface characters agree with those above described; the sides and posterior margin are bent down at a steep angle; the general form is very like that of the pygidium figured by Walcott[1] as associated with the head-shields which he refers to *Agraulos strenuus*, var. *nasutus*. The one doubtful point is the flattened upper surface of the axis, which does not exhibit the high convexity of the glabella and thoracic segments.

PYGIDIUM.—The following is the description of the associated pygidium referred with very little hesitation to this species.

General form.—Trapezoidal; wider behind than in front.

Axis.—Convex; somewhat flattened in the middle; reaching the posterior end of the shield; with no divisions except that marking off the articulating surface, which projects a little beyond the general line of the anterior border.

Side-lobes.—Subtriangular; not confluent behind the axis; front border standing out at right angles to the axis for one-third of its length and then bent suddenly backwards and slightly downwards to meet the posterior margin at a rounded angle; posterior margin almost straight and bent down vertically. In the view from behind, this hanging portion is seen to arch suddenly upwards as it approaches the axial line.

The surface of the side-lobe slopes almost uniformly backwards and outwards from the inner anterior angle, and is marked by one short depression near the same angle, representing a marginal groove. There is no trace of any spine or tubercle.

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[1] 10th Ann. Rep. U.S. Geol. Surv. 1888–89 (1890) p. 653 & pl. xcvii, figs. 1, 1 *a–c*.

This pygidium differs from that figured by Walcott in the absence of any division of the axis, and in the fact that the side-lobes are not connected together behind the axis.

The cranidia which I have referred to this species differ in several particulars from the characters shown in Dr. Walcott's figures[1] of his variety of *Agraulos strenuus*, Bill.

	Agraulos strenuus, var. *nasutus*, from Walcott's figures.	*Agraulos (Strenuella) salopiensis.*
Width at anterior facial suture	considerably less than width across eye-lobes.	slightly less than width across eye-lobes.
Width at posterior facial suture	considerably more than width across eye-lobes.	not exceeding width across eye-lobes.
Nuchal spine	broad and stout.	strong, but elongate and slender.
Glabellar furrows......	distinct.	almost obliterated.
Occipital furrow	distinct.	almost obliterated.
Axial furrow	distinct.	obsolete.
Eye-lobe	nearly half the length of the head-shield, omitting the spine.	about one-third the length of the head-shield, omitting the spine.

From *Agraulos (Strenuella ?) halliana*, Matthew, the differences of the Shropshire species are more marked. *A. (Str.) halliana* has the cheek-lobes 'connected in front of the glabella,' the frontal margin is only a little raised, the fixed cheeks have a steep slope to the axial furrow,[2] the 'tubercular process' (geniculation) of the postero-lateral margin appears to be at a less distance out from the glabella, and the eye-lobe is 'short and not prominent.'

From *Anomocare*, as figured by Angelin,[3] there are numerous differences. In all the seven species the fixed cheeks are decidedly narrow. *A. læve*, Ang., is perhaps nearest to the Shropshire species in the convexity of the axis and course of the facial suture, but the glabella, front margin, occipital ring, and free cheeks are all very different.

Locality and horizon.—Comley, from the upper part of the grey limestone of the excavation, 200 yards south of the quarry.

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[1] 10th Ann. Rep. U.S. Geol. Surv. 1888–89 (1890) pl. xcvii, figs. 2, 2*a–c*.

[2] Mr. Matthew's figures appear to have been drawn from internal casts.

[3] 'Palæont. Scan.' 1854, pl. xviii.

Anomocare, Angelin.

Mr. Philip Lake, who very kindly examined many of my specimens from Comley, suggested to me that certain of the forms belonged to Angelin's genus.

The evidence supplied by the fragments next to be described is too scanty to enable me to be certain whether they should be placed in this genus or with the preceding *Agraulos (Strenuella)*. The fragmentary pygidium [173] (Pl. V, fig. 6) is so much mutilated that it is impossible to say whether it had or had not an extended flat border similar to those figured by K. A. Grönwall as belonging to *A. excavatum*, Ang., and *A. læve*, Ang.[1]

ANOMOCARE PLATYCEPHALUM, sp. nov. (Pl. V & ? Pl. IV, fig. 10.)

E. S. Cobbold, *Anomocare*, sp. 1 & sp. 2, Rep. Brit. Assoc. 1908 (Dublin) 1909, p. 236.

This species is associated in the same rock with *Agraulos (Strenuella) salopiensis*, and appears to be equally plentiful; but, owing to the greater flatness of the head-shields, it is perhaps more easily collected, and I have about twelve nearly complete cranidia, as well as a large number of fragments.

This comparative flatness of the heads has suggested the specific name.

CRANIDIUM: Size.—Length varying from 4 to 8 millimetres.

General form.—Subquadrangular, with broadly rounded front.

General convexity.—About $\frac{1}{5}$; while the convexity is not inconsiderable, there is an absence of relief in the separate features which gives an idea of flat-headedness to this species.

Glabella.—Convex; almost parallel-sided; apex rounded semicircularly; strongly impressed at the sides by three pairs of glabellar furrows which are wide and ill-defined. The posterior furrows are always, the median frequently and the anterior sometimes, inclined backwards, and they all penetrate into the glabella for a third or more of its width, and in so doing constrict the median portion, giving it a somewhat carinate appearance. The inner ends of the posterior pairs are often wider than the outer, as though the furrow had been impressed first in one direction and then in another. In one specimen [142] the furrows are much widened, and their outlines blurred (Pl. V, fig. 2).

Occipital furrow.—Strongly impressed at the sides, but hardly traceable across the median third, where it seems partly invaded by a thickening of the occipital ring.

Occipital ring.—Expanded in the middle, both forwards and backwards; the surface is but slightly convex longitudinally and inclined backwards; in some instances, there is a slight depression across the centre parallel to the lower border. Occasionally, a very minute tubercle is visible (with a strong lens) on the axial line.

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[1] 'Bornholms *Paradoxides*lag og deres Fauna' Danmarks Geol. Undersög. ser. 2, no. 13 (1902) pp. 140, 141 & pl. iv, figs. 6, 8, 9.

Axial furrow.—Practically obsolete. The glabella is well-defined from the cheeks by the change of vertical curvature, but is less distinctly marked off from the frontal limb.

Fixed cheek.—Highest near the glabella; sloping down in a uniform curve to the eye-lobes and to the front; extending anteriorly beyond the ocular ridge and merging into the frontal limb; posterior limit marked by a rather steep downward curve.

Eye-lobe.—From a quarter to a third of the length of the head-shield; situated opposite the middle of the length of the glabella and occipital segment combined; distance from the glabella equal to the diameter of the latter; not raised at the outer edge.

Ocular ridge.—Beginning near the glabella in advance of the anterior glabellar furrow, and curving outwards and backwards to the eye-lobe.

Frontal limb.—Sloping at a very gentle curve downwards all the way; having usually (but not always) a wide, slightly thickened marginal rim, the surface of which has a slightly increased slope downwards and a delicately raised inner border.

Postero-lateral limb.—Consisting of a groove, widening outwards; and a raised border, with a geniculation at a distance outwards rather less than half the width of the glabella.

Facial suture.—Owing to the bending down of the sides of the cranidium, it is a little difficult to make out the exact form and position of the suture as viewed from above.

The anterior branch runs more or less directly forward from the eye, curves round rapidly inwards to meet the front margin, and is never farther out than the eye-lobe.

The posterior branch seems to vary slightly; it follows a sigmoidal course from the eye-lobe to the posterior angle of the cranidium, which is well rounded and usually rather farther out than the eye-lobe itself.

Test.—To the unaided eye the surface is almost smooth, but under a strong lens it proves to be finely granular, and, in one instance at least [144], a number of minute tubercles are to be seen. On the extreme front edge of the same specimen, the granular surface is seen to merge into one of fine raised lines subparallel to the border.

Owing to the mixture in the rock of the free cheeks and fragments of thoracic segments of this species with those of *Agraulos (Strenuella) salopiensis*, the correlations given below are somewhat inferential.

Free cheek.—There are several examples in my collection of the remarkable free cheek represented in Pl. V, fig. 8. The facial suture in the specimen [163] seems to be partly preserved, but the eye, which was considerably elevated above the plane area, is broken away.

The plane area is small, and the genal angle is produced into a very long and delicate spine of oval section, and stands out away from the head-shield at an angle of 30° to 40° with the axis.

The plane area exhibits a finely granular surface, comparable with that of the cranidia; this character continues into the base of the spine, and then merges into a series of irregular raised lines, much like those on the front margin of the cranidium [144]. I have attempted to express these characters in the enlargements (Pl. V, fig. 8).

A second form of free cheek [169] (Pl. IV, fig. 10) from the same rock exhibits a modification, which may indicate a different species: in this the spine is circular in section and much stronger; but I have other specimens somewhat intermediate between the two, and, so far as the evidence goes, it would seem that the setting of the spine and its sectional form are liable to variation.

Although the free cheek of this species remains somewhat doubtful, I have little hesitation in assigning the pleuræ, etc. [specimens 180 *a*, 178, 915] to it.

The keys to the discrimination between the thoracic segments of the *Strenuella* and the *Anomocare* are:—(i) the nature of the surface; (ii) the position and angle of the geniculation; and (iii) the curvature of the convexity of the axis.

THORAX.—Number of segments unknown.

Axis.—Transverse convexity less than a semicircle; articulating surface marked off from the body of the ring by a distinct transverse hollow or groove; body of the ring somewhat narrowed in the middle, by the advance of the groove from the front, and by a sinuosity of the posterior margin: there is a slight cushion-like thickening on each side at the point of attachment of the pleuræ.

Pleura.—Somewhat wider in the middle than at the axis; nearly square with the axial line throughout; horizontal for a distance about equal to half the diameter of the axis, then strongly geniculate and bent down at an angle of about 45°; the bent portion somewhat curved, convex outwards, and about a quarter as long again as the horizontal part; front rib low near the axis, marginal to the geniculation, whence it bends backward towards and beyond the centre of the pleura, leaving a wide facet in front of it; back rib low and wide near the axis, and remaining marginal throughout.

The groove between the ribs is wide and shallow near the axis, deepest at the geniculation, narrowing rapidly beyond it to die out near the extremity, which is broadly rounded.

Surface.—Finely granular.

PYGIDIUM.—I have one fragment of a pygidium [173], with a finely granular surface, that appears to belong to this species.

Axis.—Wide; consisting of an articulating surface, two annulations and a longer terminal portion; the upper surfaces of the annulations are broken away in a manner suggestive of their having borne wide-based spines directed backwards.

Side-lobe.—Consisting of a horizontal extension with a width equal to about a quarter of that of the axis; beyond this the form is entirely lost, but there are two depressions on the broken edge, which have the appearance of being the bases of two marginal spines or processes directed backwards.

Pygidial spines (?).—Two specimens of spines [178, 873] (Pl. V, figs. 7 & 9) may possibly belong to the pygidium of this species, although they are somewhat too large to fit the individual pygidium figured.

Each consists of an elongate cylindrical spine with a swollen bisymmetrical base, which is rounded above but flattened or perhaps even hollowed below. Beyond the base there is a constriction or furrow separating it from an annulation, which looks like an articulating surface, but the front edge is, in both specimens, broken and shows no margin. The surface-characters are identical with those of the free cheek [163] previously described (see Pl. V, fig. 8), being finely granular on the base, in this respect matching the pygidium figured (Pl. V, fig. 6), and graduating to a system of raised lines on the spine itself. They would appear to have projected upwards and backwards, and to have been bent more decidedly backwards at a little distance above the axis.

Associated as they are with fragments of both the *Strenuella* and the *Anomocare*, it is possible that they might belong to either genus; but the swollen base and constriction are very different from the bases of both the nuchal and the thoracic spines of the former, and the surface-characters point strongly to a reference to the same species as the free cheek [163], the characters of which again match with those of the cranidium [144] (not figured) that is referred to the *Anomocare*.

The general form of these spines is very like that of the detached 'horizontal spines' figured by the late Dr. F. Schmidt as belonging to his *Olenellus (Mesonacis) mickwitzi*.[1]

Locality and horizon.—Comley, from the upper part of the grey limestone of the excavation, 200 yards south of the quarry.

ANOMOCARE PARVUM, sp. nov. (Pl. IV, figs. 11–14.)

E. S. Cobbold, *Anomocare* sp. 3, Rep. Brit. Assoc. 1908 (Dublin) 1909, p. 236.

A minute form nearly related to *A. platycephalum*, but which seems to be specifically distinct, is found in considerable numbers in the same rock.

In general form, in convexity, and in surface-characters these cranidia have so strong a likeness to *A. platycephalum*, that it is unnecessary here to do more than indicate the differences.

The glabella is, proportionately, rather more strongly convex and somewhat less wide. The frontal limb has no thickened rim; it stands out almost horizontally from the end of the glabella, and its anterior edge is slightly upturned.

The glabellar furrows are more distinctly impressed, narrower and more uniformly transverse; and, in some instances, a fourth pair is indicated at the sides of the glabella in advance of the ocular ridge (see Pl. IV, fig. 11). The geniculation of the posterior border is proportionately farther out.

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[1] 'Ueber eine neuentdeckte Untercambrische Fauna in Estland' Mem. Acad. Imp. Sci. St. Petersb. ser. 7, vol. xxxvi (1888) no. 2, pl. i, figs. 23 & 24.

Forms referable to *A. platycephalum* have been recognized, ranging down to 4 millimetres in length of head-shield; those of *A. parvum* vary from 2·3 to 4 millimetres, but have not been found larger. It would therefore appear to be a much smaller species. Narrow and wide forms [143 & 275] of this species are illustrated by the two figures (Pl. IV, figs. 11 & 12).

The thoracic segment [172] (fig. 14) and fragmentary free cheek [177] (fig. 13) may possibly belong to this species.

Locality and horizon.—The same as in the case of *Anomocare platycephalum.*

ANOMOCARE (?) PUSTULATUM, sp. nov. (Pl. VI, figs. 1, 2, & 3.)

E. S. Cobbold, *Anomocare* vel *Agraulos* sp., Rep. Brit. Assoc. 1908 (Dublin) 1909, p. 237.

Portions of six or seven head-shields and some thoracic fragments from various exposures in the Quarry Ridge, Comley, indicate a species with a very pustulate test. Of these, two of the larger cranidia [186, 188] and one axis ring [196] are selected for illustration.

CRANIDIUM: Size—moderate,[1] 11 to 12 millimetres in length.

General form.—Subquadrangular, with rounded front; proportion of length to width = 3 : 4; widest across the eyes.

General convexity.—Considerable, about $\frac{1}{5}$; the features are in very strong relief.

Glabella.—Convex; parallel-sided; truncately rounded at the apex; having four pairs of furrows well marked at the sides, but not continuous across; the posterior pair inclined backwards, the others transverse; the anterior pair only just visible at the sides.

Occipital furrow.—Wide and deep; continuous across.

Occipital ring.—Strong; subequal in the middle to the length of the glabellar lobes, but shorter at the sides; projecting backwards beyond the general posterior margin of the shield; without spine or tubercle.

Axial furrow.—Wide and deep; not continuous round the apex of the glabella, where its place is taken by the hollow part of the frontal limb.

Fixed cheek.—Nearly equal in width to the glabella; somewhat quadrangular in outline; most elevated at about three-quarters of its width out from the glabella; in transverse section the surface rises slightly from the axial furrow, is then nearly horizontal to the highest point, from which it falls steeply down to a wide hollow parallel with the eye-lobe; this hollow is partly filled up by a buttress between the eye-lobe and the tumidity of the cheek (this is indicated by a change in intensity of the shading in the figures of both the internal and the external casts); the cheek is limited posteriorly by the steep fall of the surface to the postero-lateral limb, and anteriorly the surface falls gradually, in advance of the ocular ridge, into the hollow part of the frontal limb.

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[1] Since the above description was written, specimens referred to this species have been found, ranging from 3 to 16 millimetres in length.

Eye-lobe.—One-third of the length of the head; the posterior end reaching to the postero-lateral limb; the anterior end marked by a rather sudden falling-away in altitude where it joins the ocular ridge; distinctly elevated throughout above the hollow in its rear, but not so high as the fixed cheek.

Ocular ridge.—A ridge, rounded rather than flat; arising from the axial furrow nearly as far forward as the little impressions representing the anterior pair of glabellar furrows; passing across the cheek in a bold curve to the eye-lobe, and having a slight hollow (not an impressed line or furrow) behind it.

Postero-lateral limb.—Marked by a wide groove passing directly outwards, and a convex marginal rim, which is strongly geniculate at a distance out nearly equal to the width of the glabella; beyond the geniculation the surface of the limb falls steeply down to the facial suture.

Frontal limb.—About a fifth of the total length of the head-shield; consisting of a deep hollow and an equally wide and very convex rostral margin. These features lose intensity to right and left, and at the same time the limb curves downwards considerably.

Facial suture.—Hardly visible from above, owing to the curving over of the sides of the cranidium; anterior branch short and subparallel to the axial line; posterior branch a short curve, convex outwards; both branches less far out than the eye-lobe.

Test.—Probably rather thick and firm, but usually found weathered to a snowy-white powdery substance. The external cast [188] (Pl. VI, fig. 2) shows that it was covered nearly all over with closely set pustules or pustular spinelets (I have been unable to make a clear wax impression of these, but the holes in the cast appear to be pointed). These pustules have no corresponding impressions on the interior, and the internal cast [186] is consequently quite smooth (Pl. VI, fig. 1). The marginal modification is unknown.

Thorax.—Associated with these cranidia are a number of fragments of thoracic segments, some of which exhibit very similar surface-characters. One of these, an axis ring [196], is represented in Pl. VI, fig. 3, and is, with reserve, referred to the species under description. The crust is partly weathered away, but enough is left to show the bases of the pustules which covered the convex body of the axis; the front articulating portion is quite smooth, and in the groove the pustules are smaller.

A beautiful little upright spine stands on the centre of the ring; when found it was complete, now the point is unfortunately gone: it was quite smooth.

The pleuræ have not been sufficiently studied for description.

Locality and horizon.—Comley, from the French grey and lower part of the grey limestones of the excavation, 200 yards south of the quarry, and from the quarry itself; also from blocks of limestone found in the overlying conglomeratic bed. It is always associated with fragments showing the reticulate pattern characteristic of *Olenellus*, but has not yet been found in the red, *Olenellus* Limestone.

There is a general similarity between the cranidium of this species from Comley, as seen from above, with that of Dr. Walcott's *Solenopleura (?) howleyi*, as figured by him.[1] He describes the surface as being 'strongly granular or pustulose'; but, unfortunately, he gives no indication of the longitudinal curvature of the glabella, and the comparison cannot be carried further without seeing the specimens themselves. Mr. Matthew claims *S. (?) howleyi* as a *Protolenus*.[2] With these facts before me, I think it well to make the generic reference of the Comley form with reserve.

Protolenus, Matthew.

G. F. Matthew, Bull. Nat. Hist. Soc. New Brunswick, no. 10 (1892) p. 34; Trans. Roy. Soc. Can. vol. xi, sect. iv (1893) p. 100; and Trans. N.Y. Acad. Sci. vol. xiv (1895) p. 144.

PROTOLENUS LATOUCHEI, sp. nov. (Pl. VII, figs. 1–6.)

E. S. Cobbold, *Protolenus* sp., Rep. Brit. Assoc. 1908 (Dublin) 1909, p. 236.

This species is founded upon fragments of more than thirty head-shields derived from a few pounds' weight of the uppermost band of the grey limestone of Comley. The specific name is given in remembrance of the late Rev. J. D. La Touche, of Stokesay, whose friendship and kindly help were so long enjoyed by all students of Shropshire geology, and not least by myself.

CRANIDIUM: Size—moderate; length = from 7 to 8 millimetres.

General form.—Semielliptical: proportion of length to width = about 5 : 6.

Convexity.—Well marked; about $\frac{1}{6}$.

Glabella.—Strongly convex; distinct from the occipital ring; tapering somewhat forwards to the well-rounded extremity; about three-quarters of the total length of the head-shield; furnished with three pairs of furrows, the anterior pair very short, the two posterior pairs of medium length, directed somewhat backwards and occasionally traceable, on the cast of the interior, quite across; greatest elevation equally at the anterior and posterior lobes.

Occipital furrow.—Entire; somewhat sinuous; sharply impressed, especially on the internal cast.

Occipital ring.—Exceeding in length the posterior lobe of the glabella in the middle, but less than half of this length at the sides.

Axial furrows.—Wide and deep between the fixed cheeks and the glabella, but not marked by any impressed line.

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[1] 10th Ann. Rep. U.S. Geol. Surv. 1888–89 (1890) p. 657 & pl. xcvii, figs. 7–7 *a*. In the explanation of this plate the names *howleyi* and *harveyi* have been transposed.

[2] Trans. Roy. Soc. Can. vol. xi, sect. iv (1893) p. 102.

Fixed cheeks.—About equal in width to the glabella; nearly flat for half their width, but curving steeply down to a wide furrow, from which the surface rises again to the prominent eye-lobe.

Eye-lobe.—Moderate in size (about half as long again as a glabellar lobe); situated opposite the posterior pair of glabellar furrows; almost reaching to the posterior border.

Ocular ridge.—Commencing by a somewhat prominent rounded boss (almost a tubercle) situated close to the axial furrow and a little forward of the anterior glabellar lobe; curving outwards and backwards, the ridge rapidly loses prominence, and is only just traceable across the forward swelling of the cheek to the eye-lobe.

Postero-lateral limb.—Rather narrow; consisting of a wide furrow and a somewhat sinuous raised rim, geniculated at about three-quarters of the way out; bending down steeply to the facial suture.

Frontal limb.—Distinct from the glabella, but continuous with the cheeks; falling away with a gentle convex curvature to the marginal rim; bent down decidedly towards the sides; faint indications of radiate markings on the internal cast. The marginal rim is somewhat convex, but not recurved, and of uniform width from suture to suture.

Facial suture [524] (Pl. VII, fig. 5).—Anterior branch short and direct from the eye-lobe to the depressed border; posterior branch curving outwards and backwards to cut the posterior margin behind the eye-lobe.

Test.—Covered with closely set tubercles, which are larger on the elevated parts and sometimes hardly discernible in the hollows of the shield. On the glabella they are specially large, and more or less confluent. On the interior the tubercles are represented by little pits, which on the internal cast show as tubercles rather smaller in size than on the exterior. On the marginal rim the tubercles are replaced by elongated narrow ridges, arranged in a reticulate manner (Pl. VII, fig. 6 *b*).

Two detached free cheeks [438, 549] have been found intimately associated with the fragments of these cranidia. One of these has a portion of the test preserved, which shows characters similar to those above described. Both specimens also resemble the head-shields in the special method of preservation of the test, and I have no hesitation in assigning them to this species.

Free Cheek.—Narrow and small, with a deep pit behind the eye; the genal angle is extended backwards into a strong spine of circular section and of great comparative length.

Thorax and Pygidium unknown.

A few thoracic segments are preserved in the same rock, but are not sufficiently good to warrant description.

Locality and horizon.—Comley; from the uppermost band of the grey limestone at the excavation, 200 yards south of the quarry.

PROTOLENUS MORPHEUS, sp. nov. (Pl. VII, fig. 7.)

A distinct species, but closely allied to the one previously described, appears to be indicated by a nearly complete head-shield [566] and several fragments, from the same bed of rock. It differs principally in the glabella, but there are minor points which combine to give a decidedly different aspect to the head-shield.

CRANIDIUM: Size.—Rather smaller than the average of *Protolenus latouchei*; length = about 5 millimetres.

General form.—Semi-elliptical, but less elongate than *Pr. latouchei*; proportion of length to width = about 4 : 6.

General convexity.—About $\frac{1}{6}$.

Glabella.—Strongly convex; parallel-sided, with a well-rounded extremity; less distinctly marked off from the frontal limb than in *Pr. latouchei*, but having a similar greatest elevation in the anterior and posterior lobes; furrows deeply impressed at the sides and continuous across, straight and not inclined backwards.

Occipital furrow and ring.—Unknown.

Axial furrow.—Distinct, but less wide than in *Pr. latouchei*; sinking deeply (almost to a pit) forward of the ocular ridge.

Fixed cheek.—As in *Pr. latouchei*, but rather more tumid.

Ocular ridge.—Rather more strongly marked than in *Pr. latouchei*, and giving, in conjunction with the swollen ('puffy') cheeks, a somnolent expression to the head.

Postero-lateral limb.—Unknown.

Frontal limb and facial suture.—Apparently similar to *Protolenus latouchei*.

Marginal rim and eye-lobe.—Unknown.

The test of this species has the same superficial characters as that of *Pr. latouchei*; but possibly it was stronger, for, so far as known, it is always in a better state of preservation. In this respect it recalls the test of *Microdiscus comleyensis*, sp. nov., from the same bed of rock, notwithstanding that this latter is punctate instead of tuberculous.

Locality and horizon.—The same as those of *Pr. latouchei*.

I am indebted to Mr. Lake for pointing out to me that these species belong to Mr. Matthew's genus. They differ considerably from his three described species; the Comley forms seem to have comparatively short eye-lobes, the free cheeks figured have a relatively smaller area and a much longer spine, and the frontal limb is more extended.

Mohicana, gen. nov.

Intimately associated with the specimens of *Protolenus* and *Microdiscus comleyensis*, and apparently confined to the same 3-inch bed of grey limestone, fragments of rather larger trilobites occur, having characters very similar to those of *Micmacca (?) plana*, Matthew, which species Mr. G. F. Matthew only referred provisionally[1] to his genus.

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[1] Trans. N.Y. Acad. Sci. vol. xiv (1895) p. 143 & pl. xi, figs. 2 *a*–2 *b*.

The evidence available for description is meagre, and the following is necessarily an incomplete diagnosis.

Cephalon.—Semi-oval, moderately convex, features in slight relief. Glabella, proportionately long and wide, outlined by a decided but not deep axial furrow. Glabellar furrows slightly impressed or wanting. Occipital furrow complete, wide and shallow. Occipital ring plain, or produced to a spine. Fixed cheeks wide, gently and evenly convex, continuous with the frontal limb. Eye-lobe long, distant from the glabella, low in elevation, not raised at the edge. Ocular ridge slight or wanting. Postero-lateral limb geniculated about half way out. Facial suture short and direct, both forwards and backwards. Anterior margin with narrow indistinct fold, or none. Free cheek small, pointed, or spined.

Thorax and pygidium.—Unknown.

MOHICANA LATA, sp. nov. (Pl. VI, fig. 4.)

Only one specimen [578] is confidently referred to this form at the present time.

CRANIDIUM: Size—moderate; length = about 13 millimetres.

General form.—Semi-elliptical, approaching semicircular; proportion of length to width = about 4 : 5.

General convexity.—Moderate; but, owing to the very slight relief of the features, there is an appearance of flatness. Speaking generally, there is one uninterrupted sweeping curve from the front and sides to the top of the glabella.

Glabella.—Wide and flattened; parallel-sided, with rounded apex; distinct from the occipital ring; no transverse furrows seen.

Occipital furrows.—Wide, shallow, and entire.

Occipital ring.—A plain band with curved margin; as wide as the glabella; no spine or tubercle.

Axial furrow.—Wide and shallow; continuous round the apex of the glabella.

Fixed cheeks.—Narrower than the glabella; gently convex; most elevated close to the glabella; continuous with the frontal limb; falling rather steeply to the eye-lobe, which stands away from it horizontally.

Eye-lobe.—Half as long as the glabella; almost reaching the postero-lateral furrow; situated at a low level on the head-shield; horizontal in transverse section. The specimen figured [578] has now lost the eye-lobe, but it is still to be seen in the external cast, from which, and from an earlier drawing, it has been reproduced in the enlargement.

Ocular ridge.—None seen.

Posterior border.—A more or less triangular area with a wide groove next the cheek, and a raised and rounded rim at the margin, geniculated about half way out.

Frontal limb.—Gently convex downwards; no marginal rim is preserved in the specimen.

Facial suture.—Not actually seen; there is no room, however, for anything but a fairly direct and short branch forwards, and the posterior branch would seem to have been likewise short and direct.

Test.—A small portion of the test is still visible in the right-hand corner of the specimen; it is almost smooth (? worn), with very slight indications of punctæ.

Locality and horizon.—Comley; from the uppermost band of the grey limestone at the excavation, 200 yards south of the quarry.

MOHICANA CLAVATA, sp. nov. (Pl. VI, figs. 5–9.)

Several fragments of this allied species have been found; the most complete of these [586, 582, 584] are figured in Pl. VI.

CRANIDIUM: Size—moderate; length = from 8 to 12 millimetres.

General form.—Doubtful.

General convexity.—Moderate; about the same as in *Mohicana lata*, but with more relief of the features.

Glabella.—Moderately convex; slightly clavate; length, about three-fifths of the head-shield; width doubtful; distinct from the occipital ring; slight indications of two transverse furrows on the posterior half of the glabella, not visible at the sides; apex rounded; greatest elevation a little behind the middle of the length.

Occipital furrow.—Entire; wide and shallow.

Occipital ring.—A plain band, slightly wider than the base of the glabella.

Axial furrows.—Shallow, but sharply impressed; slightly sinuous; well marked round the apex of the glabella.

Fixed cheeks.—Wide (?); gently and evenly convex; most elevated close to the glabella, and falling away in a fairly even convex curve to the frontal limb and to the eye-lobe which stands away horizontally.

Eye-lobe.—Fairly large, distant from the glabella, not reaching the posterior border; situated opposite the middle of the head-shield; slightly rounded transversely; with an impressed line inside it; not raised at its outer edge.

Ocular ridge.—Just visible as a raised fillet across the cheek; continuous from the eye-lobe to the axial furrow.

Postero-lateral limb.—Marked by a wide furrow; somewhat curved, with the curvature convex backwards, and margined by a raised rounded rim, which is strongly geniculated about half way out.

Frontal limb.—Gently convex; continuous with the cheeks; marginal rim not seen in any of the specimens.

Facial suture.—Not seen.

Test.—Under a strong lens the surface is seen to be beautifully marked all over by closely-set minute punctæ or pits, which have no corresponding processes on the interior. It is estimated that there are as many as 150 to 200 to the square millimetre, and that the interspaces are about one and a half times as wide as the diameters of the punctæ. These interspaces have a continuous level surface, and answer to Dr. Walcott's description and figure of the corresponding feature in his *Avalonia manuelensis*—'inosculating raised lines giving the appearance of pits'.[1]

Free cheek.—One fragment [584] of a free cheek presenting the same surface-characters has been noticed. It may be described as spherically triangular; small; and having the genal angle produced to a short spine, which is oval in cross-section. I have attempted to show in Pl. VI, fig. 8 the modification of the surface-characters as they approach the outer margin. The meshes of the network become squeezed out and elongated, until little is to be seen but a set of irregular raised lines.

Locality and horizon.—Comley; from the uppermost band of the grey limestone, at the excavation 200 yards south of the quarry.

These two species have many points of resemblance with *Micmacca (?) plana*, Matthew.[2] The large glabella 'descending gradually at the front, and bordered by a distinct, but faintly impressed dorsal furrow,' the faint occipital and glabellar furrows, the slight convexity of the cheeks, and the proportions between their width and that of the glabella, are all points in common. It seems evident that the three species are congeneric.

With *Avalonia manuelensis*, Walc., there is a striking resemblance in the characters of the test of *Mohicana clavata*; and with *Avalonia acadica*, Matthew,[3] there is a general resemblance in the view from above, but the peculiar grooves on the line of the ocular ridge are absent, and the frontal limb is more extended.

Concluding Remarks.

It would be premature to discuss at length the exact age of the beds which have yielded the trilobites here described, until the remainder of the fauna has been more fully worked out. I would, however, call attention to the fact that the specimens of *Protolenus* occur at Comley a little above the horizon of *Olenellus (Holmia) callavei*, Lapw., and below the lowest local representative of the genus *Paradoxides*. This is in entire agreement with the position assigned to the genus by Mr. G. F. Matthew, at his type locality at Hanford Brook.

It also seems of interest to note that several of the Comley forms from the *Olenellus* and the grey limestones, namely, *Microdiscus helena*, Walc., *M. speciosus*, Ford, *M. lobatus*, Hall, and *Ptychoparia (?) attleborensis*, Sh. & F. (as also *Agraulos strenuus*, Bill., which seems closely related to the Shropshire *Strenuella*), are found in America low down in the *Olenellus* Zone, the last two being quoted by Dr. Walcott[4] from the base of the *Olenellus* Zone at Manuel's Brook (Newfoundland).

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[1] Proc. U.S. Nat. Mus. vol. xii (1889) p. 44; and 10th Ann. Rep. U.S. Geol. Surv. 1888–89 (1890) p. 646 & pl. xcv, figs. 3, 3 *a*.

[2] Trans. N.Y. Acad. Sci. vol. xiv (1895) p. 143 & pl. xi, figs. 2 *a*–2 *b*.

[3] *Ibid.* p. 140 & pl. ix, fig. 5.

[4] 10th Ann. Rep. U.S. Geol. Surv. 1888–89 (1890) pp. 650, 654.

I would take this opportunity of very gratefully acknowledging my indebtedness to Mr. Philip Lake, who kindly examined a great number of my specimens and advised me as to their relationships.

I am also indebted to Mr. W. Rupert Jones for very kindly supplying me with most of the references in this paper, in addition to his trouble in looking out and sending me works of reference from the Library of the Society.

EXPLANATION OF PLATES III–VIII.

[The numbers in square brackets are those attached to the individual specimens. Unless otherwise stated, all the specimens are in my collection for the Geological Excavations Committee of the British Association.]

PLATE III.

[The minute figures are of the natural size, the enlargements are to 5 diameters.]

Microdiscus comleyensis, sp. nov.—Uppermost band of the grey limestones, Comley. (See p. 21.)

Figs. 1 & 2. Cephala [479, 478], exteriors.
Fig. 3. Pygidium [507], exterior.
4. Pygidium [508], showing internal cast of axis.

Ptychoparia (?) annio, sp. nov.—*Olenellus* Limestone, Comley. (See p. 24.)

Figs. 5 & 6. Cranidia [402, 403], exteriors.
Fig. 7. Cranidium [401], internal cast.
8. Cranidium; restored outline; the parts shown by broken lines are hypothetical.

Micmacca (?) parvula, sp. nov.—*Olenellus* Limestone, Comley. (See p. 30.)

Fig. 9. Cranidium [412], internal cast.
10. Cranidium [411], exterior.

Ptychoparia (?) attleborensis, Sh. & F.—*Olenellus* Limestone, Comley. (See p. 23.)

Figs. 11 & 12. Cranidia [406, 405], exteriors.
Fig. 13. Cranidium [576], internal cast.

Figs. 14, 15, & 16. *Microdiscus helena*, Walcott.—*Olenellus* Limestone, Comley. (See p. 23.)

Pygidia [385, 386, 387], test partly preserved.

Microdiscus lobatus, Hall.—Uppermost band of the grey limestone, Comley. (See p. 22.)

Fig. 17. Cephalon [453], exterior.
18. Pygidium [445], exterior.

PLATE IV.

Agraulos (Strenuella) salopiensis, sp. nov. (See p. 31.)

Fig. 1. Cranidium [161]; from above, from behind, and from the right × 3, and natural size from above.
2. An anterior thoracic segment [164]; from above, from behind, and from the right × 3, and natural size from behind.
3. A median thoracic segment [162], showing base of spine; from above, from behind, and from the right × 3, and natural size from behind.
4. A smaller and, possibly, more posterior thoracic segment [176]; from behind and from the right × 3, and natural size from behind.
5. Pygidium [274], probably belonging to this species; from above, from behind, and from the right × 3, and natural size from above.

Fig. 6. Free cheek [170]: *a*, as seen flatways in the rock; *b*, as seen from the side; *c*, approximately as seen from above, when attached to the cranidium, × 3; *d*, part of spine, enlarged to 6 diameters to show surface-characters.

7. Extremity of a right pleura [180] × 3, to show the incipient hook.

8. Extremity of a left pleura [944] × 3, to show the hook more pronounced.

9. Extremity of a left pleura [948] × 3, to show the hook still more pronounced.

Fig. 10. *Anòmocare* sp. (See p. 38.)

Free cheek [169], × 3; indicating either a variety of *A. platycephalum*, sp. nov. (see Pl. V), or a distinct species.

Anomocare parvum, sp. nov. (See pp. 39–40.)

Figs. 11 & 12. Cranidia [143, 275], from above, from behind, and from the right × 3; and of the natural size from above.

Fig. 13. Free cheek [177] × 3, possibly belonging to this species.

14. Thoracic segment [172], possibly belonging to this species: from above and from behind × 3; and of the natural size from behind.

[All these specimens are from the upper part of the grey limestone, Comley, immediately below the narrow band with *Protolenus*, etc.]

Plate V.

Anomocare platycephalum, sp. nov. (See pp. 36–39.)

Figs. 1, 2, & 3. Cranidia [160, 142, 911], showing variation in the inclination and distinctness of the glabellar furrows: from above, from behind, and from the right × 3; and of the natural size from above.

4 & 5. Thoracic segments [915, 180]: from above, from behind, and from the left × 3; and of the natural size from behind.

Fig. 6. Incomplete pygidium [173], referred with reserve to this species: from above, from behind, and from the left × 3; and of the natural size from above.

7. Pygidial? spine [178], referred with reserve to this species: from above and from the left × 3, and natural size from above. (The side view is, unfortunately, shaded as if lighted from the right.)

8. Free cheek [163] referred to this species: from above and from the right × 3, with enlargements to show surface-characters.

9. Pygidial? spine [873], showing bisymmetrical base: from above and from the right × 3, with enlargement of part of the spine to show the surface-characters.

[All these specimens are from the upper part of the grey limestone, Comley, immediately below the narrow band with *Protolenus*, etc.]

Plate VI.

Anomocare (?) pustulatum, sp. nov.—The French grey limestone, Comley. (See pp. 40–42.)

Fig. 1. Cranidium [186], internal cast, from a detached block in Comley Quarry: from above, from behind, and from the right × 3; and of the natural size from above.

2. Part of cranidium [188], external cast, showing casts of the pustules, × 3; from a block embedded in the *Paradoxides*-bearing conglomeratic grit, Comley.

3. Thoracic segment, axis only [196]: from behind and from above × 3, and of the natural size from behind; from the limestone *in situ*, Comley.

Mohicana lata, gen. et sp. nov.—Uppermost band of the grey limestone, Comley. (See pp. 45–46.)

Fig. 4. Cranidium [578]: from above, from behind, and from the right × 3; and of the natural size from above.

Mohicana clavata, gen. et sp. nov.—Uppermost band of the grey limestone, Comley. (See pp. 46–47.)

Fig. 5. Glabella and fixed cheek [586]: from above, from the left, and in section across the middle of the head × 3; and of the natural size from above.

6. Surface of the test of the same specimen [586], enlarged to about 10 diameters.

7. Free cheek [584] × 3 and of the natural size.

8. Surface of the test of the same specimen [584], enlarged to about 10 diameters.

9. Fixed cheek and eye-lobe [582], doubtfully referred to this species, × 3 and of the natural size.

PLATE VII.

Protolenus latouchei, sp. nov.—Uppermost band of the grey limestone, Comley. (See pp. 42–43.)

Fig. 1. Part of left free cheek and genal spine [549]; × 3 and of the natural size.

2. Cranidium [524]: from above, from behind, and from the right × 3; and of the natural size from above.

3. Right free cheek [438]; × 3 and of the natural size.

4. Part of cranidium [525], showing frontal limb: from above and from the right × 3; and of the natural size from above.

5. Right fixed cheek [524], showing eye-lobe and facial suture: from above × 3 and of the natural size.

6. Glabella, occipital ring, and frontal limb [533]: from above × 3 and of the natural size; with enlargements (*a*) of front border, and (*b*) of a glabellar lobe, to show the surface-characters.

Protolenus morpheus, sp. nov.—Uppermost band of the grey limestone, Comley. (See p. 44.)

Fig. 7. Cranidium [566]: from above, from behind, and from the right × 3; and of the natural size from above.

Micmacca (?) ellipsocephaloides, sp. nov. (see also Pl. VIII).—*Olenellus* Limestone, Comley. (See pp. 27–28.)

Fig. 8. Cranidium [413], test well preserved: from above, from behind, and from the right × 3; and of the natural size from above.

9. Cranidium [J 12905, Brit. Mus. (Nat. Hist.) Coll.], test a little weathered, and presenting a beautiful white egg-shell appearance: from above, from behind, and from the right × 3.

PLATE VIII.

Micmacca ellipsocephaloides, sp. nov. and varieties. (See pp. 27 *et seqq.*)

Fig. 1. The type form [200], test partly destroyed: from above, from behind, and from the right × 3; and of the natural size from above.

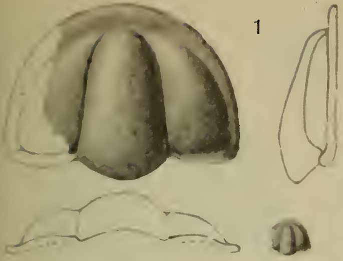
2. Var. *senior*, nov. [J 12901, Brit. Mus. Coll.], all features much thickened, facial sutures convergent forwards, divergent backwards: from above, from behind, and from the right × 3. (See p. 29.)

3. Var. *strenuelloides*, nov. [J 12902, Brit. Mus. Coll.]; frontal limb produced, facial sutures more convergent forwards and divergent backwards: from above, from behind, and from the right × 3.

4. Fixed cheek [J 12902, Brit. Mus. Coll.]: facial suture intermediate between the type and fig. 3; × 3. (See p. 29.)

5. Var. *spinosa*, nov. [J 12900, Brit. Mus. Coll.]: frontal limb short, occipital ring produced to a short spine; × 3. (See pp. 28–29.)

6. Var. *strenuelloides*, nov. [J 12904, Brit. Mus. Coll.]: cranidium and traces of seven thoracic segments; facial sutures somewhat convergent forwards, glabella somewhat conical; from above, from the back of the head, and from the right × 3. (See p. 29.)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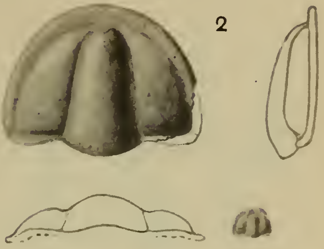
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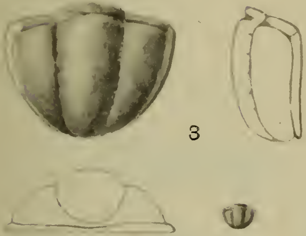
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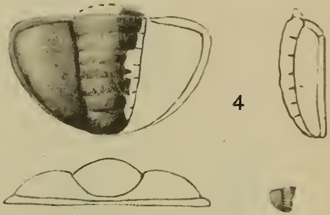
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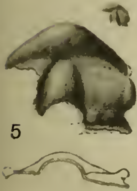
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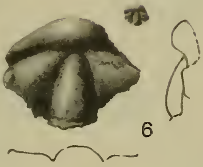
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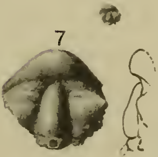
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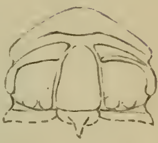
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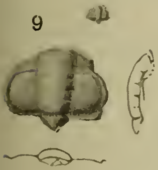
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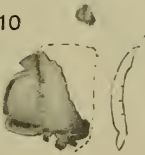
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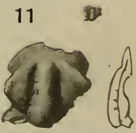
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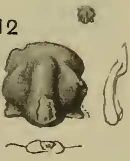
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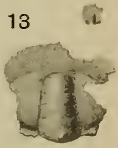
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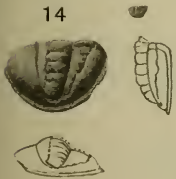
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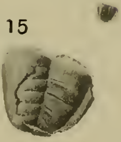
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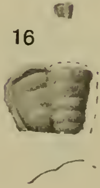
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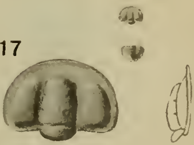
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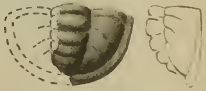
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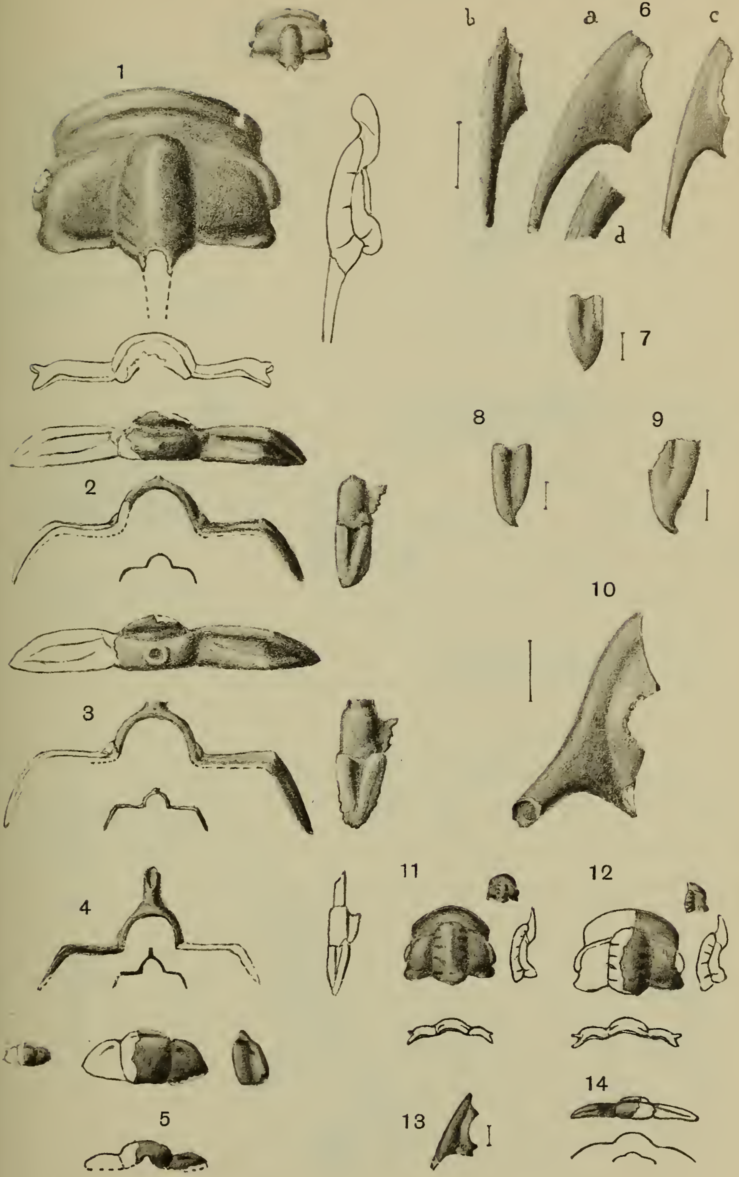
CAMBRIAN TRILOBITES FROM COMLEY.



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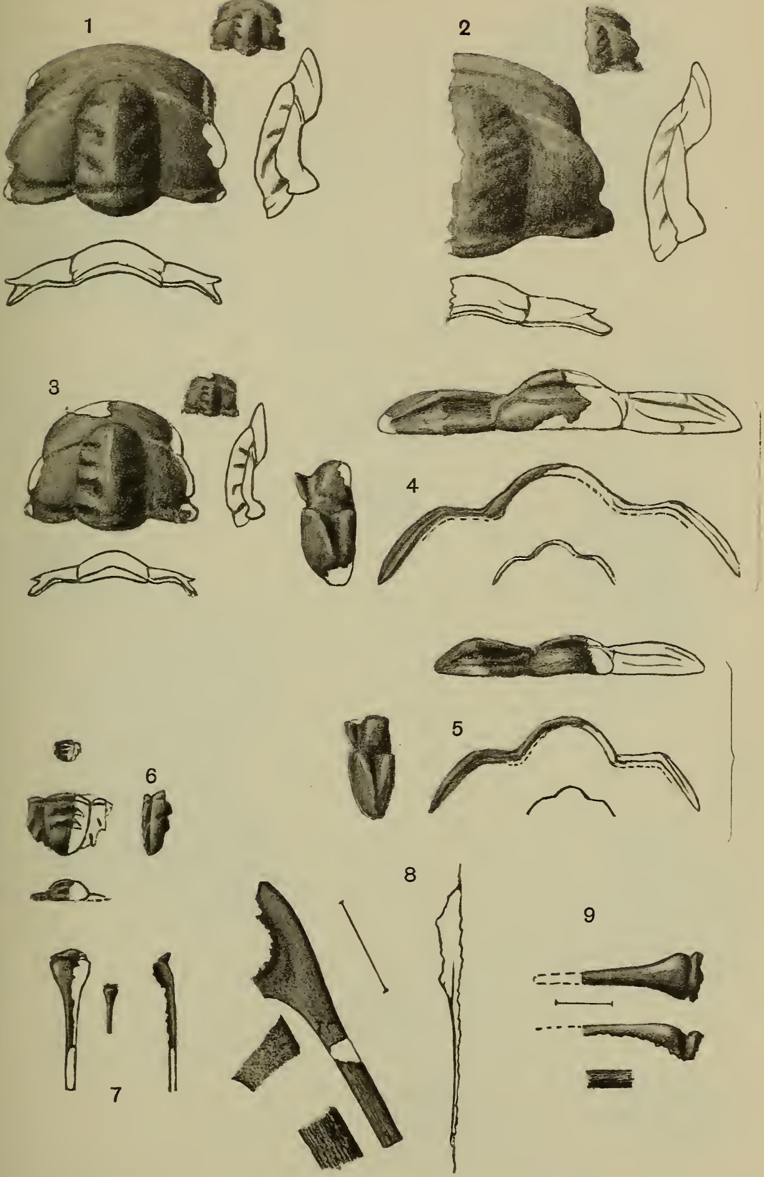

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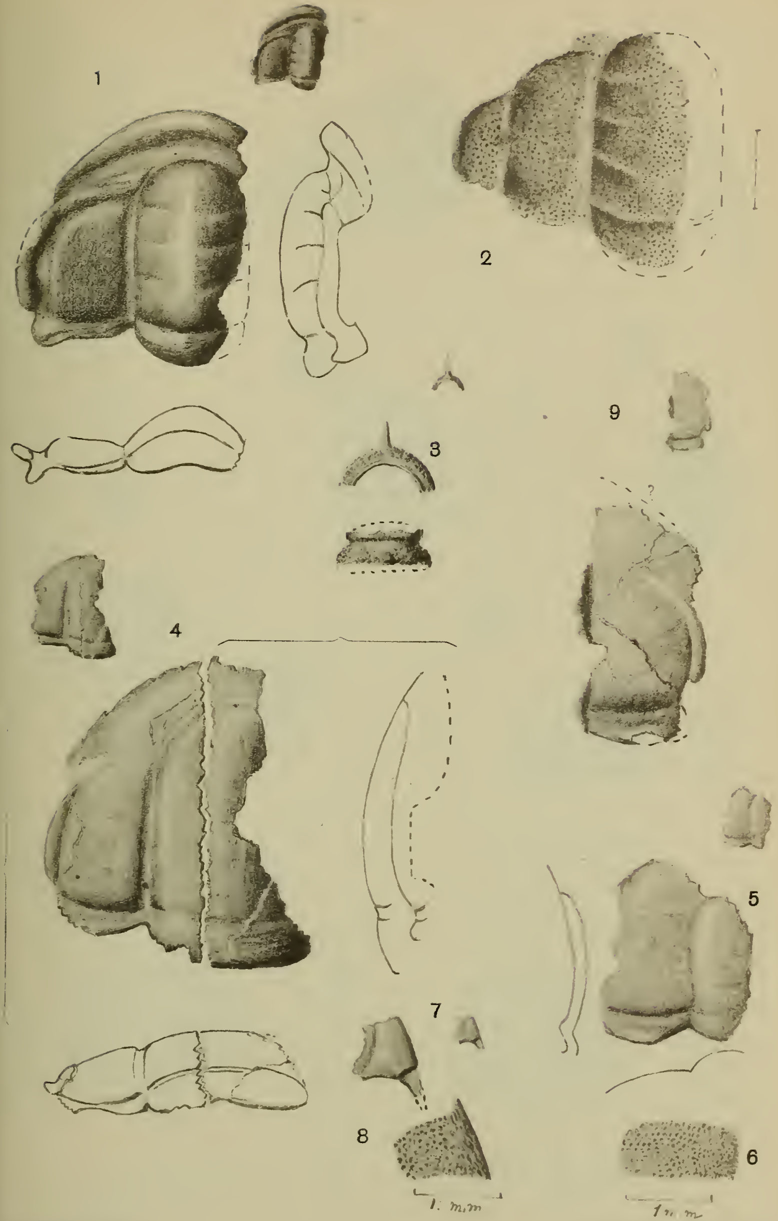

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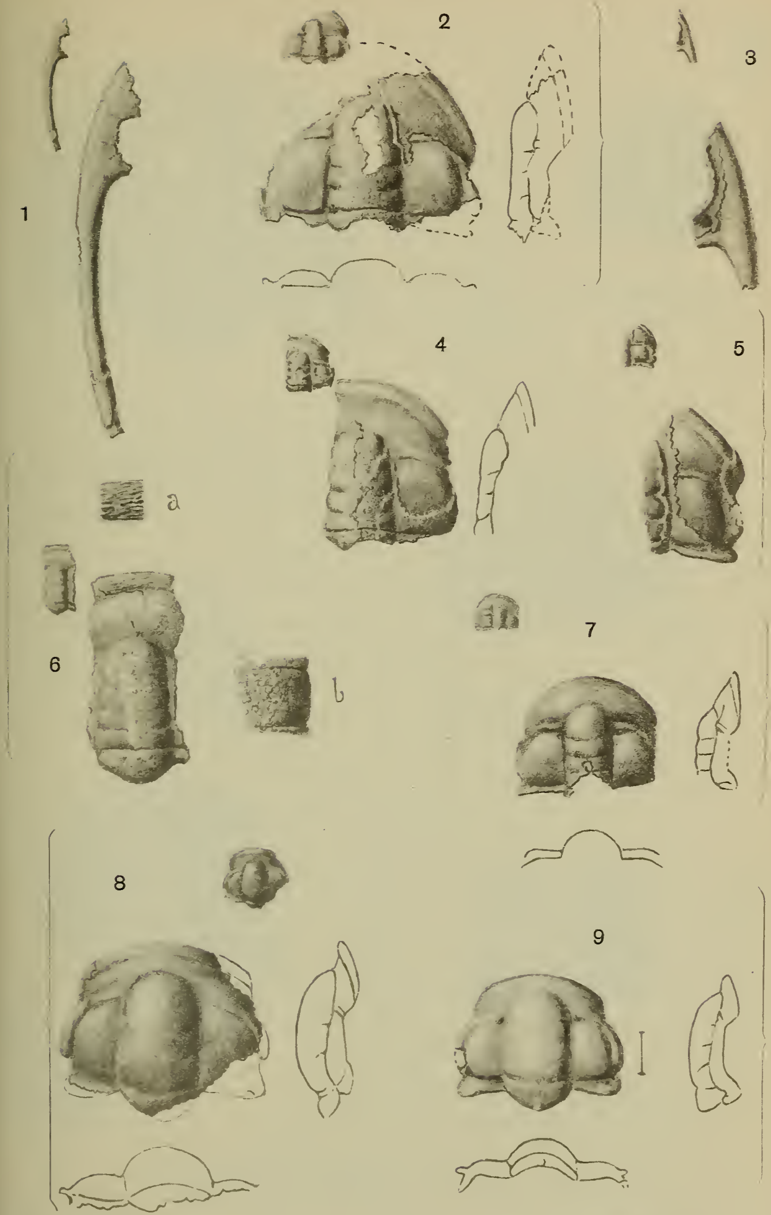

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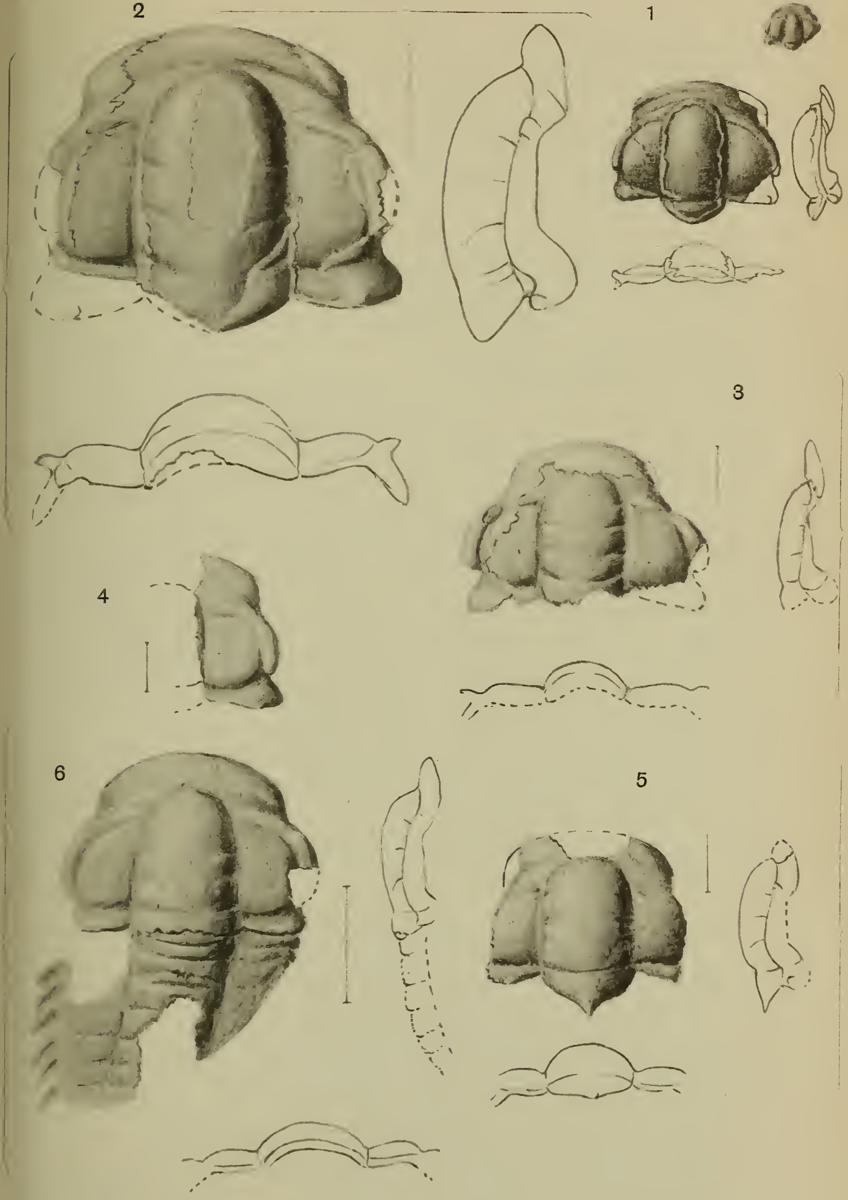

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Discussion.

The President (Prof. W. J. Sollas) welcomed this important contribution to our knowledge of the Lower Cambrian faunas; it was no small triumph to have established a standard succession by work in so restricted an area as Comley Quarry. The material was fragmentary, and to have elicited so much sound information from it reflected the greatest credit on the Author's skill and insight. The determination of the true horizon of the *Protolenus* Fauna was in itself a noteworthy achievement.

Dr. Marr congratulated the Author on having discovered the relative positions of the *Olenellus*, *Protolenus*, and *Paradoxides* Faunas in the British Cambrian sequence. In the quarry at Comley, which he had visited with Prof. Lapworth, were white and pink crystalline limestones containing *Olenellus*. These limestones were similar to others in various regions exhibiting what Mr. Tiddeman called 'reef-knoll' structure, although in this case the structure was on a very small scale.

Prof. Watts said he was glad that the Author had obtained such splendid results from his excavations in Shropshire. It was most interesting to find a representative of the *Protolenus* Fauna coming between the *Olenellus* and *Paradoxides* Faunas.

Mr. Fearnsides, as secretary to the 'Excavation of Critical Sections' Committee of the British Association, wished to congratulate the Author on the great success of his trench-digging operations. The discovery of three distinct faunas within a thickness of 6 feet of coarse-textured sediment was of great interest. It drew attention to the sharp contrast between the Lower Cambrian rocks of Shropshire and of Merionethshire, and showed that the Comley rocks were much more like the contemporaneous rocks of the Baltic area. The erosion-partings, the minute unconformities between successive beds, the limestone pellets associated with phosphatic nodules and glauconitic grains, could all be matched exactly among the Cambrian rocks of Northern Öland, and were there interpreted as distinctive of a period of recurrent alternating deposition and erosion in shallow water of the sea-bed.

The Author briefly thanked the Fellows for their appreciative reception of his paper, and in reply to Dr. Marr said that the position of the genus *Protolenus* at Comley was exactly parallel with that assigned to it by Mr. Matthew in Acadia. He also explained that the paper was only concerned with one preliminary excavation at Comley, and that the further excavations, made under the grant from the Committee for Geological Excavations of the British Association, had yielded results extending to other horizons in the Shropshire Cambrian. To a suggestion made by Mr. Fearnsides, he replied that he regarded the grey limestones as shallow-water deposits, possibly laid down in lagoon-like relics of the *Olenellus* sea, the bottom of which was gradually raised above sea-level, to be subsequently eroded by the advance of the *Paradoxides* waters.